

treatment designs (for storm and non-storm drainage). These provisional targets (Table 4-2) are intended to be conservative and, thus, the design of stormwater treatment systems based on those targets should be able to meet the final PLRGs. It is assumed that by meeting c.1943 loading rates, water quality and clarity in the affected lagoon segments should improve sufficiently to enable seagrass to expand to the 1943 coverage depths. Application of the PLR Model will help ascertain whether these provisional targets are reasonable or too stringent (and thus should be revised).

For Banana River Lagoon, the determination of final nutrient PLRGs may, in part, be hinged on the role of macroalgae (*Gracillaria* spp., *Caulerpa prolifera*) in regulating nutrient concentrations in the water column. Banana River Lagoon, particularly its central area (segments BR3-5 and BR6), typically contains large masses of drift macroalgae, which function as a nutrient “sponge” and can thereby limit the availability of nutrients to phytoplankton. Phytoplankton can effectively compete with seagrass for available light in the water column and, as mentioned before, may be the primary “optical” pollutant in Banana River Lagoon (as indicated by chlorophyll *a* concentrations). If macroalgae densities were to decline, would phytoplankton levels increase, further restricting available light to seagrasses? Are the relatively high macroalgae densities in Banana River Lagoon an indication that nutrient levels may already be excessive? Answers to these questions are not known, which suggests that it may be wise to explore the ecological role of macroalgae in the IRL system in the context of both nutrient and seagrass management.

Table 4-3. Provisional “allowable” loading rates for TN, TP, and TSS for Banana River Lagoon based on estimated 1943 land use loading rates

(see Figure 4-1 or Figure 4-2 for map location of segments)

Segments	TN lb/ac/yr (total lb/yr)	TP lb/ac/yr (total lb/yr)	TSS lb/ac/yr (total lb/yr)
N. Banana R. BR1-2	3.2 (106,989)	0.21 (7,020)	34 (1,146,101)
C. Banana R. BR3-5	3.3 (26,820)	0.38 (3,145)	90 (739,603)
Newfound Harbor BR6	2.2 (13,530)	0.37 (2,275)	35 (217,851)
S. Banana R. BR7	2.9 (13,163)	0.23 (1,076)	32 (145,860)

Land Acquisition. The acquisition of lands and “buffer” shorelines is viewed as a key strategy toward the protection and restoration of wetlands and seagrasses. This strategy is pursued largely through the IRL *Blueway* program. The *Blueway* program, its scope and progress, is described in the section on Coastal Wetlands found in this and the other chapters.

In addition to the acquisition of lands that comprise critical habitats or habitat buffers, other lands are sought for the purpose of constructing and operating surface water

storage/treatment systems. Open land areas, if appropriately sized and strategically located in the drainage basin, may be good sites for such a purpose. But, these lands need to be acquired first and that can be a very expensive proposition considering the market value of coastal Florida real estate. To meet that financial challenge head-on, funding partnerships are formed among governmental agencies, and even nonprofit entities, on a routine basis. For example, SJRWMD has assisted and will consider assisting local governments in the acquisition of lands intended as sites for surface water management, particularly if the site serves a substantial portion of a watershed.

Unfortunately, open land of sufficient size is scarce in the urbanized central and southern sub-basins of Banana River Lagoon. Therefore, the feasibility of a single, large-scale project meeting sub-basin PLRGs or other major drainage improvements is relatively low. Consequently, street-by-street or individual subdivision drainage treatment projects incorporated within the existing drainage infrastructure are the types of projects that are being conceived and constructed.

An exception can be made for the minimally developed northern watershed of Banana River Lagoon. If it is determined that non-point sources in this area require significant treatment and it is economical to construct a large-scale project to achieve PLRGs, then the pre-requisite land requirements should be much easier to meet than farther south. Moreover, these lands are federally owned and managed; thus the need to publicly acquire land is not an issue.

Coordination with Other Agency Plans. Since urban non-point source pollution is the major problem in the central and southern Banana River Lagoon, it is important for the local governments to continue developing surface water plans with input from SJRWMD. Currently, SJRWMD is working with the cities of Cape Canaveral, Cocoa Beach and Satellite Beach to complete their respective master plans. The SJRWMD (including IRLNEP), the FDEP and EPA (section 319 non-point source reduction grant program), can then review city projects in the context of their master plans, and provide cost-share funding to support qualified projects.

With respect to the northern reach of Banana River Lagoon, NASA and U.S. Fish and Wildlife Service (USFWS) are consulting with SJRWMD on a full range of land development mitigation measures intended to improve estuarine water quality (e.g., runoff containment/treatment) and wetland functions (e.g., reconnection, breaching, etc.).

SJRWMD and NASA are engaged in a fairly comprehensive set of monitoring and data base coordination activities. NASA has agreed to applying its resources in acquiring and managing a variety of environmental data (e.g., seagrass coverage, water and air quality data, meteorological data, etc.). This data base coordination will benefit all agencies interested in the Banana River Lagoon and the IRL system as a whole.

The Next 5 Years

Strategies for Pollutant Load Reduction

Non-point Source Strategy – Surface Water Drainage. The completion of master surface water management plans and their implementation is the key objective that

should play out over the next 5 years in the basin's major urban centers: Canaveral, Cocoa Beach, Satellite Beach, and unincorporated Merritt Island. The SJRWMD will consider cost-share agreements with these local governments to implement their plan projects and will provide what grant application assistance it can to the local governments to procure other funding support.

Non-point Source Strategy – Muck. Approximately one million cu yd of muck reside in southern Banana River Lagoon, including the residential canals (Mr. Shailesh Patel, BCI, Inc., personal communication, Oct., 2000). It is here where the removal of muck would be most beneficial relative to other Banana River Lagoon segments where comparatively little muck has accumulated. Unfortunately, there is not sufficient land area in southern Banana River Lagoon to support a de-watering operation that could handle any more than 50,000 to 100,000 cu yd of dredge material per year (and the dredge window is typically between December and March when manatees are not present in large numbers).

De-watering technology is, at present, fairly expensive; approximately \$10 per cu yd of dredged material (in addition to the dredge cost of \$4 to \$7 per cu yd). Hopefully the cost will drop as demand for such technology grows. Current funding priorities for muck removal projects place southern Banana River Lagoon at fifth position, or fourth position at best, behind Crane Creek (completed), Turkey Creek (completed), and Sebastian and Eau Gallie rivers (planning is underway; therefore beginning and completion dates for dredging are unknown at this time).

Consideration should be given to developing a long-range plan for the removal of major muck deposits at all priority sites throughout the IRL basin (10 major sites, including southern Banana River Lagoon). The plan would include the method and results of the site prioritization, and an estimated permit and dredge schedule for each project site along with general budget information.

Non-point Source Strategy – Septic Tanks. Septic tanks are now considered a fairly low management priority in the Banana River Lagoon basin because of the remedial work accomplished in 1990s. It is most important in this basin to focus resources on the volume reduction and treatment of urban drainage. Nonetheless, the SJRWMD would support county expansion of centralized WWTP service to Horti Point, the only remaining and significant area that still relies on septic tanks.

Point Source Strategy – Domestic Wastewater Treatment Plants. Like septic tanks, domestic WWTPs appear to be a minor source of pollution to Banana River Lagoon thanks to local government action in response to the IRL "No Discharge" Act (Chapter 90-262, Laws of Florida). The IRL program should turn its full attention to the volume reduction and treatment of urban drainage, and to muck sediment management.

Monitoring, Modeling, and Applied Studies. The SJRWMD, Brevard County, NASA and other participating agencies will continue the seagrass and water quality monitoring networks described in Chapter 2 (pp. 2-15 and 2-16). These same agencies will also jointly evaluate and refine the monitoring networks to strengthen empirical relationships among water quality, light, and the depth coverage of seagrass. Analyses and reporting of monitoring data will key in on salinity trends and those major optical pollutants that may be significant in the Banana River Lagoon: color, TSS, and phytoplankton (measured as chlorophyll *a*).

The role of macroalgae (e.g., *Gracillaria spp.*) in controlling the availability of nutrients to phytoplankton may be important in an estuary that exhibits an extremely sluggish flushing rate like Banana River Lagoon. This phenomenon will be further explored with respect to its nutrient management implications.

An updated survey of muck distribution, volume, and characteristics (physical and chemical) will be conducted as a planning requirement for any future dredge operations, which would likely occur in southern Banana River Lagoon (segment BR7). Also, a post-dredge sediment survey and monitoring of water quality characteristics will help document the utility of muck removal in achieving water quality objectives.

By 2004 the PLR Model should be verified and ready to be applied toward the development of recommended final PLRGs for the Banana River Lagoon. In the meantime, provisional pollutant load reduction targets can be used in stormwater treatment designs (see Table 4-2). These provisional targets are intended to be conservative and, thus, be used to design municipal or regional stormwater treatment systems that should be able to meet the final PLRGs. The SJRWMD will use the PLR Model to “test” the adequacy of the provisional targets. If they are determined to be too stringent, the targets may need to be relaxed or re-set at levels that are more economically achievable but can still meet the water quality/light requirements for seagrass restoration.

Land Acquisition. Acquisition of relatively large parcels of open land, in order to construct stormwater treatment basins, is not part of any existing plan to treat surface water drainage in the urban corridors on the barrier island and Merritt Island. Treatment facilities sized to serve several acres or one to two sub-divisions at best appear to be the most viable options. Brevard County and the barrier island cities are planning on constructing numerous small or modest sized projects whose collective treatment capabilities should meet both water quality and flood protection objectives.

For information on wetland acquisition and other lands for the sake of restoration or preservation, refer to the Coastal Wetlands section below (and in the other chapters).

Coordination with Other Agency Plans. NASA is consulting with SJRWMD on a range of mitigation measures related to future development of their space facilities. Some of the mitigation measures could be directed at the treatment or full containment of runoff from hundreds of acres of both new and old development areas for the benefit of the northern reach of Banana River Lagoon. This mitigation plan should also incorporate wetland reconnection/restoration projects as well as water quality improvement measures.

SJRWMD and NASA have entered into a formal collaboration (via memorandum of understanding) to coordinate both agencies’ monitoring and data base management efforts. It is believed that this will tremendously boost data and information exchange not just between the two agencies, but also among all the key management agencies interested in the IRL system.

With respect to the central and southern Banana River Lagoon, it cannot be emphasized enough that it is most important to reduce and treat the discharge of urban storm drainage. The cities of Cape Canaveral, Cocoa Beach, and Satellite Beach are

developing plans that should strive to address both the quality and quantity of runoff, and more specifically the PLRGs or “allowable” loading rates for TSS and nutrients. It is hoped that the cities will finalize their project plans by 2002 followed by aggressive implementation of projects over the next 5 years and beyond. Toward that end, the SJRWMD can assist the cities with technical guidance, direct funding support, and by applying for other sources of funds.

Table 4-4. The 5-Year Plan List of Seagrass and Water Quality Projects for the Banana River Lagoon

- **Continue monitoring in the Banana River Lagoon as part of the Lagoon-wide monitoring networks***
 - **Water Quality Monitoring (NASA, SJRWMD)**
 - **Seagrass Mapping and Field Monitoring**
 - **Meteorological Monitoring**
 - **Hydrodynamic Monitoring**
- **Develop final PLRGs by 2004**
- **Implement non-point, surface water projects aimed at reduction of nutrient, TSS, and freshwater inputs (Brevard County, Cape Canaveral, Cocoa Beach, Satellite Beach, Indian Harbor Beach)**
- **Re-survey muck deposition areas**
- **Continue periodic inventory of domestic WWTPs**
- **Continue to support actions by the county in any further remediation of septic tank areas (e.g, Horti Point on eastern Merritt Island)**
- **Pursue acquisition of lands identified under the *Blueway* program**
- **Investigate the value of macroalgae as a habitat and as a potentially major mediator of nutrient loadings**

* descriptions of monitoring networks are found in Chapter 2, and listed in Table 2-4.

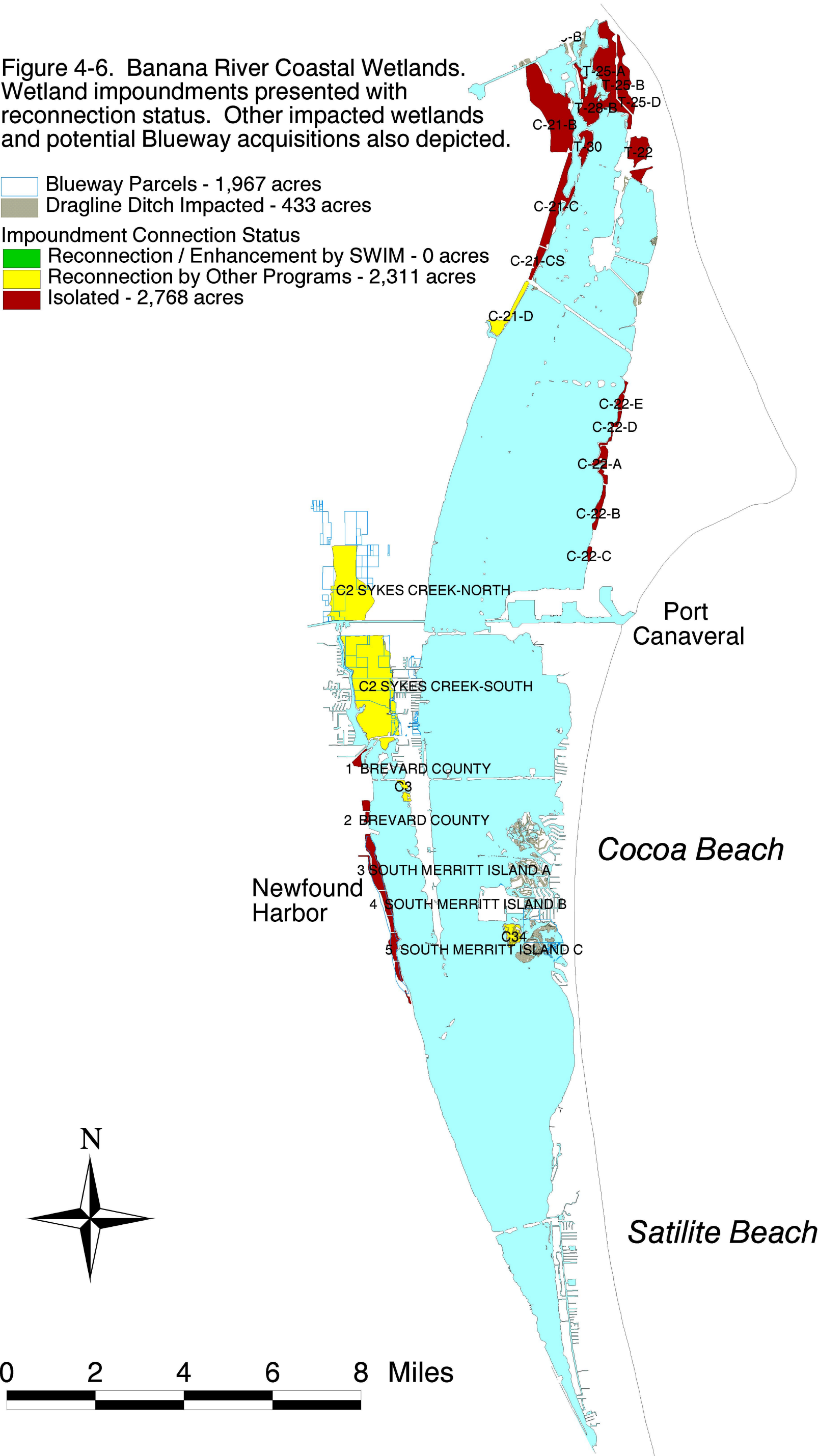
Coastal Wetlands

Banana River Lagoon contains approximately 5,600 acres of coastal wetlands, which includes 5,079 acres of impounded wetlands (Figure 4-6). Just under half of these impounded wetlands (2,311 acres) have adequate connection to the Banana River Lagoon; the majority of those are the Sykes Creek impoundments (2,074 acres). Out of the remaining impoundments, 2,668 acres are targeted for reconnection. Although many of these targeted impoundments are publicly held, others are threatened by imminent development. Acquisition of these wetlands is critical for their rehabilitation and protection.

Banana River Lagoon also has dragline-impacted marsh -- over 430 acres. A portion of these wetlands is privately owned and will probably need to be publicly acquired in order to accomplish any rehabilitation. Rehabilitation of these wetlands will include cooperative efforts by SJRWMD, Brevard Mosquito Control District, USFWS, NASA, and the U.S. Air Force (Cape Canaveral Air Force Station).

Figure 4-6. Banana River Coastal Wetlands. Wetland impoundments presented with reconnection status. Other impacted wetlands and potential Blueway acquisitions also depicted.

- Blueway Parcels - 1,967 acres
- Dragline Ditch Impacted - 433 acres
- Impoundment Connection Status
- Reconnection / Enhancement by SWIM - 0 acres
- Reconnection by Other Programs - 2,311 acres
- Isolated - 2,768 acres



Progress on Projects

Please refer to the Coastal Wetlands section in Chapter 2 for a description of the general background and scope of the projects. Progress information is provided below.

Rehabilitation of Impounded Wetlands. About half of the 5,079 acres of impoundments in Banana River Lagoon are under Federal ownership. Most of these are part of the Kennedy Space Center and are managed by USFWS. The rest are part of the Cape Canaveral Air Force Station. Except for one breached impoundment, all of the impoundments in Federal ownership are still isolated and are targeted for reconnection and restoration. As stated above, the largest group of reconnected wetlands is the Sykes Creek impoundments (2,074 acres), which were reconnected as part of a mitigation project. SWIM project funds have not been used to date to reconnect any of the impoundments in the Banana River Lagoon. Among the privately held wetlands, the ones most threatened by development are impoundments 3, 4, and 5 along the western shore of Newfound Harbor (Figure 4-6). These wetlands are high on the priority list for the IRL *Blueway* Project. In summary, 2,311 acres of wetlands were reconnected, breached, or restored in Banana River Lagoon.

Wetlands Management Research Initiative. Although the Wetlands Management Research Initiative is not being conducted in Banana River Lagoon, its results and recommendations can be considered in managing reconnected impoundments throughout Banana River Lagoon.

Rehabilitation of Other Impacted Wetlands – Dragline-Ditch Impacts. No work on these impacted wetlands has been done or is currently underway. A plan that includes a schedule and cost for rehabilitation is in progress.

Creation of Shoreline Vegetative Habitats. Kelly Park, a county recreational park, located on Merritt Island immediately south of the S.R. 528 causeway, was the site for two mangrove planting projects. Both projects dealt with red mangrove (*Rhizophora mangle*) planting, but each differed in the type of planting method used. The first planting took place in early spring 1997 using the traditional and simple method of inserting nursery grown stock (mature propagule showing shoot and leaf growth) directly into submerged sediments along the shoreline without the aid of any wave barrier or other means of protection. The second planting occurred in the fall of 1998 using the recently developed “encasement planting technique” described by Riley and Kent (1999). The encasement is a PVC pipe cut to 3 ft lengths, inserted into the shoreline sediment, and into which the mangrove propagule and sediment growing media are placed. The PVC encasement protects the propagule from wave and wind disturbance, floating debris, and foot traffic. The latter plantings using the encasement method enjoyed a 96% survival rate over a 21-month period; whereas only 24% of the first plantings survived in the first 6 months. The latter plantings are still maturing, showing excellent promise as a means to re-vegetate and stabilize shorelines and improve wildlife habitat.

Preservation of Existing Wetlands – Land Acquisition. Many of the wetlands are in public ownership; nonetheless, land acquisition is a critical issue in the Banana River Lagoon basin. There are 1,967 acres of wetlands included in the IRL *Blueway* Project, mostly in the Sykes Creek/Newfound Harbor area. Some of the Newfound Harbor wetlands are under imminent development threat. This is considered by the SRJWMD as the highest priority area for public acquisition under the *Blueway* Project.

The Next 5 Years

Rehabilitation of Impounded Wetlands. The objective for the next year or 2 is to acquire and reconnect the Newfound Harbor impoundments. Over the next 5 years, the objective is to reconnect or restore all the remaining isolated impoundments on federal land in the Banana River Lagoon basin. The NASA mitigation plan should move the program closer to that end.

Wetlands Management Research Initiative. The same agencies that manage most of the wetlands in Banana River Lagoon are involved in or are being made aware of the Research Initiative: Brevard Mosquito Control District, USFWS, NASA, and the U.S. Air Force. These agencies can readily apply the research findings to their respective management policies and programs that affect impounded wetlands in this lagoon. It is expected that they will participate in the development of management recommendations, which should begin by latter half of 2003.

Rehabilitation of Other Impacted Wetlands – Dragline-Ditch Impacts. The pilot project to evaluate equipment and technique options in the rehabilitation of dragline-impacted wetlands was conducted in Mosquito Lagoon. The evaluation report should be completed by December 2002 or by early 2003. A work plan for the 430+ acres of dragline-impacted wetlands in Banana River Lagoon will follow. At this time, it is not feasible to accurately project the amount of work or progress possible (schedule and cost) over the next 5 years.

Creation of Shoreline Vegetative Habitats. There are no plans for creating wetland habitat or conducting any future plantings in the Banana River Lagoon under the SJRWMD IRL program.

Preservation of Existing Wetlands – Land Acquisition. The objective over the next 5 years is to acquire as much of the 1,967 acres of wetlands that are identified in the *Blueway* Project plan. Acquisition support services should be maintained to ensure momentum and success. Because of the imminent threat of development of the Newfound Harbor impoundments, most of the acquisition effort in the Banana River Lagoon should be directed toward those lands.

Table 4-5. The 5-Year Plan List of Coastal Wetland Projects for the Banana River Lagoon

- **Acquire and reconnect the Newfound Harbor impounded wetlands, a high priority under the *Blueway* program**
- **Acquire all remaining *Blueway* parcels (1,967 acres)**
- **Reconnect any of the available impounded wetland acreage on Federal property (up to 2,768 acres)**
- **Initiate plan to rehabilitate dragline-impacted wetlands (~430 acres) in Banana River Lagoon basin**

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